Miscellaneous Map No. 43

eologic Map of the West Half of the Taylor, Texas, 30 × 60 Minute Quadrangle:

Central Texas Urban Corridor, Encompassing Round Rock, Georgetown, Salado, Briggs, Liberty Hill, and Leander

Edward W. Collins

map + text

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BUREAU OF ECONOMIC GEOLOGY

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CONTENTS

Figures

ABSTRACT

A 1:100,000-scale surface geologic map of the west half of the Taylor, Texas, 30 × 60 minute quadrangle shows the areal distribution of bedrock and surficial geologic units and faults for this corridor, which is undergoing rapid urban and suburban growth. The map was constructed using field mapping, aerial photographs, existing maps, and 1:24,000-scale open-file geologic maps that were digitized, coded, and compiled in a Geographic Information System (GIS). The map illustrates outcrop belts of Lower and Upper Cretaceous strata representing about 2,000 ft of shelf deposition, Quaternary terrace deposits and stream alluvium, and upper Tertiary faults of the Balcones Fault Zone. Three Lower Cretaceous carbonate units, the Comanche Peak, Edwards, and Georgetown Formations, compose the prolific northern segment of the Edwards aquifer and its recharge zone. Important resources of the region include groundwater; rock for aggregate, building stone, and lime; and gravel. Knowledge of faults and contrasting rock types and physical attributes of the geologic units within the map area aids land-use decisions, such as planning construction projects, designing foundations, and meeting demands for construction materials.

Keywords: Balcones Fault Zone, Central Texas, Edwards aquifer, environmental and urban geology, geologic map

INTRODUCTION

Miscellaneous Map No. 43 describes the physical geology of a Central Texas area undergoing rapid urban and suburban growth. The study area lies within the Interstate 35 and U.S. Highway 183 corridor north of Austin, Texas, and the area encompassing Round Rock, Georgetown, Salado, Briggs, Liberty Hill, and Leander (fig. 1), as well as parts of northwestern Travis, western Williamson, southern Bell, and northeastern Burnet Counties, part of the regionally important Edwards aquifer's north segment and recharge zone, and part of the Balcones Fault Zone.

An objective of this report is to provide basic geologic information on the 1:100,000-scale geologic map constructed for this study, which, in turn, is a useful source of geological information about this part of the Central Texas urban-growth corridor. Population increases within this corridor have created demands on Earth resources and have caused increases in construction activities. The map area is typical of the Central Texas areas where geological considerations are key to managing and planning the use of land and water resources, as well as to responsible, cost-effective construction (Flawn, 1965; Woodruff, 1979). Information provided by the map and this report is intended for a diverse audience comprising professionals in geology, hydrology, engineering, urban planning, archeology, and related fields, as well as laypersons and students, all who have varying levels of knowledge of geology. The map can help users identify geologic features that impact activities related to planning land use, designing construction projects, and managing groundwater resources. Applied uses of the map and this report include (1) identifying aquifer recharge areas; (2) characterizing attributes and heterogeneities within aquifer strata; (3) identiying faults; (4) assisting water-management decisions on groundwater flow and aquifer response to pumpage and recharge; (5) providing

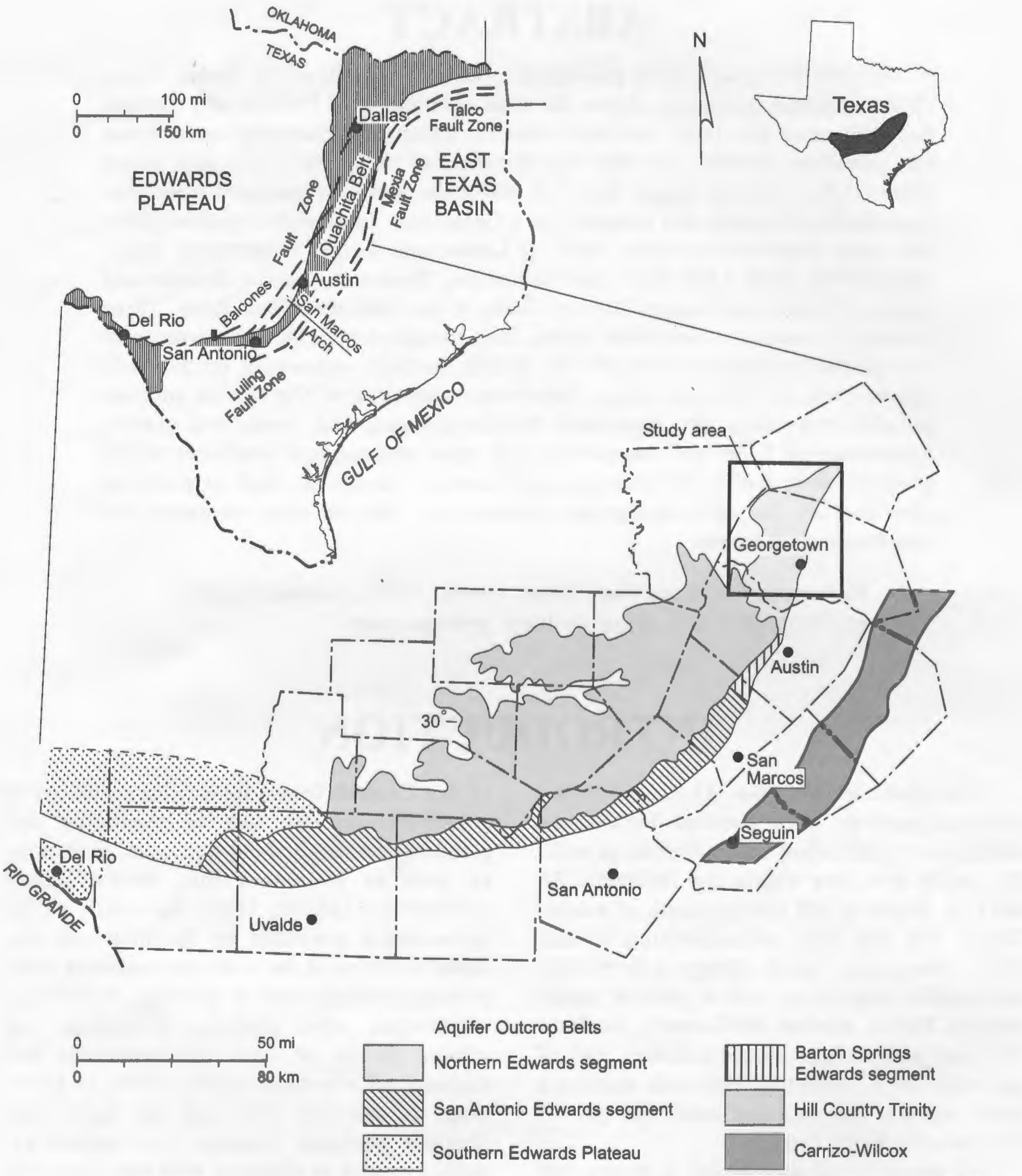

Figure 1. Location and setting of map area, which includes most of the northern Edwards aquifer segment.

information on land-use activities such as planning and permitting of construction, design of foundations, and location of landfills and other waste-disposal sites; and (6) meeting demands for local construction materials.

Methods

The study consisted of (1) reviewing and compiling existing geologic literature and interpretations, (2) studying and interpreting aerial photographs, (3) mapping geologic units

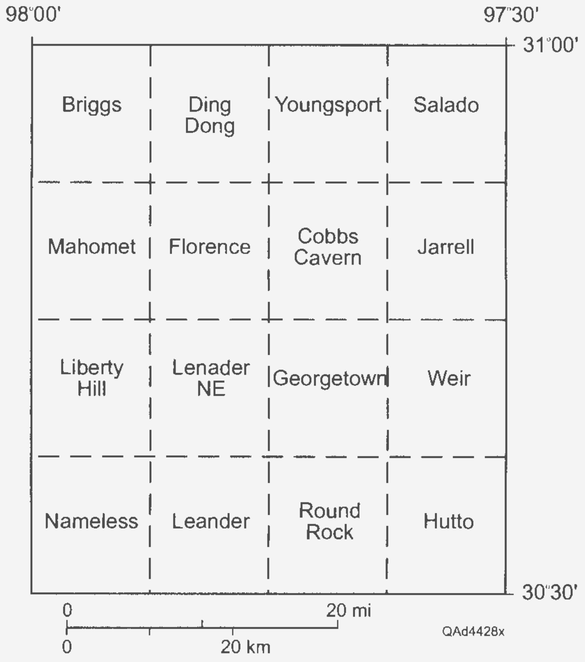

Figure 2. Names of 16 open-file geologic quadrangle maps, scale 1:24,000, that compose the study area.

and structural elements in the field using standard techniques, and (4) preparing geologic work maps of the study area. Sixteen open-file geologic maps, scale 1:24,000, of the study area were constructed between 1997 and 1999 as part of the Texas STATEMAP program (fig. 2). Black-and-white aerial photography used in the study included a variety of photographs taken between 1950 and 1995, having scales between 1:20,000 and 1:63,500. Photographs were viewed in stereo, and a zoom transfer scope was used to transfer some of the geologic data interpreted on the photographs to the 1:24,000-scale base maps. Sixteen open-file maps (fig. 2), scale 1:24,000, were digitized and assembled into a seamless data set for production of the 1:100,000-scale map (map). Digital map data also appear in an ARCINFO-format database (Tremblay and others, 2001).

The region is generally vegetated enough to make mapping difficult, and public access is typically limited to public roads and public areas at Lake Georgetown and Stillhouse Hollow Lake. Geologic unit contacts and faults are portrayed on the map by solid and dashed lines to reflect the relative certainty with which features can be located in the field and observed on aerial photographs. Unit contacts and faults drawn as solid lines are relatively more distinct in the field and on photographs than those drawn as dashed lines. Dotted lines show where faults are covered by alluvium.

Previous Work

The study benefited from, and builds on, many previous geologic investigations done within and near the study area. A regional 1:250,000-scale map that encompasses the project area exists but is not digital (Proctor and others, 1974). Previous maps of different parts of the study area include works by Adkins and Arick (1930), Marks (1950), Walls (1950), Ward (1950), Gordon (1951), Tydlaska (1951), Hartwig (1952), Arrington (1954), Atchinson (1954), Rogers (1963), Moore (1964), and Collins (1987). These workers, and others cited later, also established useful stratigraphic relationships that were used in this study.

The work of Garner and Young (1976) and Garner and others (1976), which discusses the environmental geology of Austin, immediately south of the map area, and the work of Woodruff (1975) southwest of the map area, provided information about land use and geology in the region. The earlier studies address aspects of land use related to stratigraphy, structure, topographic conditions, soils, surface drainage, rock types and their properties, mineral and water resources, and vegetation applicable to much of the Central Texas region. In this region complex geologic conditions are the setting for dramatic processes related to stress on the uses of land and water related to rapid urban and suburban growth (Woodruff and Collins, 2001a). This study also benefited from information on landscape, stratigraphy, faulting, water resources, springs, construction materials, karst, and issues related to urbanization and geology of the mapped area and nearby Austin that has been presented in a number of Austin Geological Society guidebooks (Woodruff and others, 1985; Young and Woodruff, 1985; Snyder and others, 1986; Yelderman, 1987; Collins and Laubach, 1990; Woodruff and Sherrod, 1996; Woodruff and Collins, 2001b).

GEOLOGIC SUMMARY

Geology of the map area is dominated by Cretaceous strata that dip ~1° eastward and the Tertiary Balcones Fault Zone (map). In general, the surface and near-surface geology of the study area records a series of geologic events that span ~110 million years, from Early Cretaceous time to the present. The west part of the study area is marked by the outcrop belts of Lower Cretaceous units: the Glen Rose, Paluxy (minor), Walnut, Comanche Peak, Edwards, and Georgetown Formations. These units are often associated with hilly rangeland, rocky soils, and weathered surface bedrock. Rocks of these Lower Cretaceous units, deposited mostly in marine-shelf and shelf-margin settings, include limestone, dolomitic limestone, dolomite, argillaceous limestone, marl, and some minor sandstone (Moore, 1964, 1996; Rodda and others, 1966; Wilbert, 1967; Young, 1967; Stricklin and others, 1971; Rose, 1972; McFarlan and Menes, 1991; Kerans and Loucks, 2002). During the Early Cretaceous, a peninsula and islands existed west of the map area near the Llano region; there, sediments were being deposited in fluvial, shorezone, and nearshore marine environments (Young, 1972).

The east part of the map comprises outcrop belts of the Upper Cretaceous Del Rio, Buda, and Eagle Ford Formations and Austin and Taylor Groups. This eastern map area typically is used as farmland. Relatively thick clay-rich soils cover most bedrock. The Upper Cretaceous sedimentation record for the study area indicates that cyclic sea-level fluctuations affected a broad, generally low-relief marine shelf area (Hayward and Brown, 1967; Young, 1967; Sohl and others, 1991). Regional regression and transgression during the beginning of the Late Cretaceous resulted in deposition of Del Rio clay- and mud-rich deposits and Buda limestone. After subaerial exposure of the Buda, an episode of shelf inundation coincided with Eagle Ford shale deposition.

Eagle Ford shale deposition was followed by a period of abundant chalk and carbonate deposition of the Austin Group. Outside the study area, the rock record indicates that Cretaceous volcanism coincided with upper Austin and lower Taylor deposition (Ewing and Caran, 1982; Sohl and others, 1991). During the latter part of the period, Taylor deposits experienced a gradual increase in terrigenous sediment influx.

Between 24 and 5 million years ago (mostly Miocene), faulting along the Balcones zone caused the west part of the map area, and the region west of it, to be uplifted relative to the east part of the map area. Normal faults of the Balcones Fault Zone cut Cretaceous rocks and generally follow the north-northeast regional strike of the Cretaceous outcrop belt and structural grain of the buried Paleozoic Ouachita fold and thrust belt (Sellards and Baker, 1934; Weeks, 1945; Flawn and others, 1961; Murray, 1961; Ewing, 1991a, b; Collins and Hovorka, 1997). Balcones faults, marking the edge of the Texas coastal plain, may be a manifestation of gulfward extension, flexure, and tilting along the perimeter of the Gulf of Mexico. Most movement on the Balcones Fault Zone is thought to have occurred during the late Oligocene or early Miocene (Weeks, 1945). Timing of fault movement corresponds roughly to regionally extensive Basin and Range tectonism that affected western North America, although it is unknown whether Balcones faulting and the distant deformation of western North America are related. Another possible origin of the extension that formed Balcones faults is downdip slippage on Jurassic salt. A series of normal faults composing the Milano and Mexia zones that lie ~30 to 40 mi east, parallel to the Balcones zone, may be breakaways that formed above the edge of Jurassic salt, marking updip termination of thin-skinned extension (Jackson, 1982). Balcones faults probably did not form solely by slip on salt because they lie west of the salt pinch-out, although this deformation may have coincided with and contributed to Balcones faulting.

Balcones faulting and related uplift on the regional upthrown fault block, including the Edwards Plateau, caused increased stream gradients that resulted in increased rates of erosion and incision of strata (Young, 1972). Possibly during the late Pliocene to early Pleistocene, ~1.6 million years ago, stream gradients lowered to a gradient at or near the prefaulting gradient, and relative erosion rates on the two sides of the fault zone may have decreased (Young, 1972).

Several notable streams flow eastward across the study area: Lampasas River, Salado Creek, North Fork San Gabriel River, South Fork San Gabriel River, and Brushy Creek. Quaternary terrace and channel alluvium associated with these streams and their tributaries overlie older bedrock units. Remnant Tertiary to Quaternary alluvial deposits locally cap bedrock deposits at elevations higher than deposits associated with the modern streams.

Springs are relatively common in the study area, particularly within the strata of the Edwards aquifer. Springs and streams of the area have been an important element in both the history and settlement of the region (Scarbrough, 1973). These same streams and springs, as well as the region's aquifers, continue to be important resources of the region.

Lithostratigraphy

The Lower and Upper Cretaceous rocks that dominate the map area record ~2,000 ft of marine shelf deposition that spanned ~30 Ma (fig. 3). Affected by cyclic relative sea-level fluctuations, these rocks represent seven 3rd-order depositional sequences that extended from Albian through Campanian chronostratigraphic stages, although detailed sequence chronostratigraphy for Upper Cretaceous deposits of the study area has not been done (Yurewicz and others, 1993; Moore, 1996; Amsbury, 2002; Kerans and Loucks, 2002). In general, the sequences contain deposits of transgressive facies overlain by highstand facies, and these sequences are bounded by unconformities.

Moore (1996) noted that upper Glen Rose rocks within the study area represent highstand carbonate-platform facies of a 3rd-order depositional sequence. Glen Rose sediments are overlain by another depositional sequence comprising Paluxy lowstand siliciclastic sediments, Walnut and Comanche Peak rocks representing transgressive facies, and Edwards deposits of highstand carbonate platform facies. Moore (1996) interpreted Georgetown deposits, overlying Edwards rocks, to be another 3rd-order depositional sequence. Upper Cretaceous depositional sequences that overlie Georgetown rocks contain (1) Del Rio shale-Buda limestone; (2) Eagle Ford shale, which is bounded by condensed zones (Adkins, 1932; Feray, 1949); (3) Austin Group limestone and chalk; and (4) Taylor Group marl.

The Glen Rose Formation, consisting of limestone, argillaceous limestone, and dolomitic limestone with wackestone, packstone, and lesser grainstone textures, constitutes the oldest Lower Cretaceous strata exposed in the study area. Only the upper 200 ft of this ~800-ft-thick unit are at the surface. Characteristic Glen Rose stair-step topography caused by alternating resistant and recessive beds results from the common, upward-shoaling, subtidal to tidal-flat, cyclic deposition (Stricklin and others, 1971; Moore and Bebout, 1989). Fossils include mollusks, rudistids, oysters, echinoids, and the foraminifer *Orbitolina*. Dinosaur tracks have been found locally (Moore and Bebout, 1989; Moore, 1996). Some strata exhibit vuggy porosity and karst features. An interval of one to three thin beds containing the bivalve *Corbula* informally divides the lower and upper Glen Rose Formation throughout Central Texas (Stricklin and others, 1971; Pittman, 1989). Only upper Glen Rose rocks are at the surface in the map area. Recent soil studies within Glen Rose terrain outside the map area indicate that soils overlying some limestone beds are degraded and nearly impervious, whereas other soils overlying more argillaceous beds are thicker and have more water-infiltration and water-holding properties (Marsh and Marsh, 1994; Woodruff and others, 1994; Wilding, 1997).

The Paluxy Formation is a thin, <10-ft-thick interval of quartz sandstone that is interbedded with limestone. It overlies Glen Rose rocks and interfingers with lower Walnut strata at the northwest part of the map area. Moore and

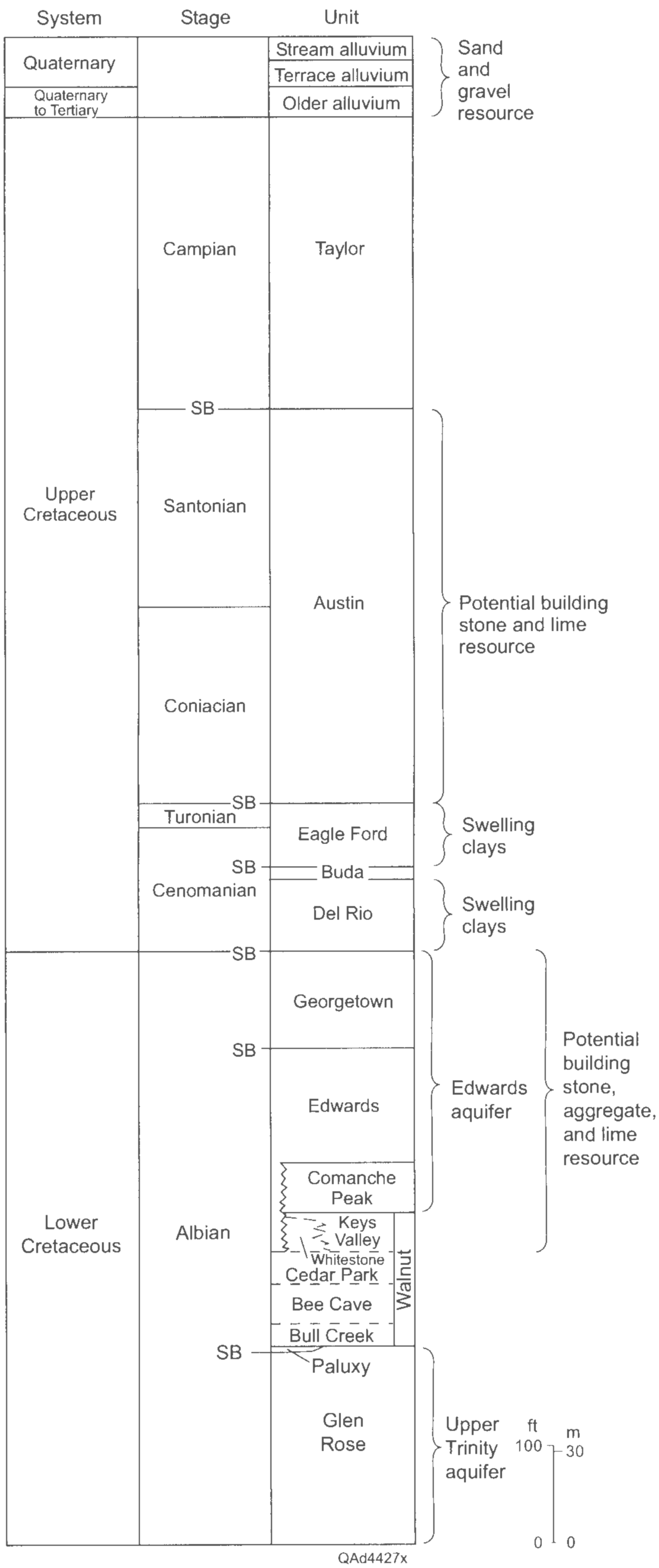

Figure 3. Generalized stratigraphic column and geologic resources. SB=3rd-order depositional sequence boundary. Stratigraphic relationships, chronostratigraphic stages, and 3rd-order sequence boundaries modified from Moore (1964; 1996), Salvador and Muneton (1989), and Yurewicz and others (1992).

Martin (1966) and Moore (1996) demonstrated that the thin Paluxy deposits of the map area mark the edge of a lobate-shaped clastic deposit having a geometry that is typical of a small delta that may have developed southward from the main area of Paluxy deposition.

Walnut Formation limestone, argillaceous limestone, and marl overlie the Glen Rose and minor Paluxy deposits. Walnut deposits represent a transgressive facies and were subdivided into six members by Moore (1964; 1996): the Bull Creek limestone, Bee Cave marl, Cedar Park limestone, Whitestone limestone, Keys Valley marl, and the upper marl. Individual members are ~30 to 50 ft thick. Walnut carbonate rocks exhibit mudstone, wackestone, and packstone textures. Common fossils include oysters, clams, echinoids, and gastropods. In the southwest part of the map area and beyond, the Whitestone and Keys Valley members and the younger Comanche Peak Formation interfinger with Edwards Limestone (map, inset diagram). Moore (1996) noted that the lower Walnut members thin and onlap Glen Rose strata toward the southwest, onto the San Marcos Arch. Following Rose's (1972) interpretation, rocks equivalent to the lower Walnut southwest of the Colorado River are part of the Edwards stratal sequence. Walnut rocks are not considered aquifer units of the Northern Edwards aquifer, although limestone intervals of the Walnut could locally contain water or allow some recharge to the aquifer.

The Comanche Peak Formation consists of nodular, fossiliferous limestone with wackestone and packstone textures. It interfingers with Edwards limestone in the southwest part of the study area. It is typically between 40 and 70 ft thick, thickening toward the north and pinching out southwest of the map area. In the southwest map area, the thin interval of Comanche Peak limestone is mapped with Walnut and Edwards rocks as an undivided unit (plate) because absence of outcrops prevented proper mapping of the thin formation as a separate unit. Comanche Peak rocks make up the lower part of the Edwards aquifer northern segment, although Edwards Formation strata are considered the aquifer's most porous rocks (Senger and others, 1990; Jones, 2002).

The Edwards Formation comprises massive to thin-bedded limestone, dolomitic limestone, dolomite, and minor argillaceous limestone that have wackestone, packstone, and grainstone textures. The unit thins from ~300 to 90 ft northward across the map area. Rodda and others (1970) described the Edwards in the Austin area as a formation consisting of four informal members differentiated on the basis of lithology (from base to top): (1) a lower interval of chert-rich, thin- to thick-bedded, porous dolomite and dolomitic limestone and limestone commonly with rudists; (2) a unit of interbedded thin- to thick-bedded cherty limestone, containing fossils that include rudists and miliolid *Foraminifera*, and thin-bedded flaggy limestone; (3) a unit of nodular, fossiliferous, burrowed, argillaceous limestone and marl; and (4) an upper interval of thin- to thick-bedded limestone, dolomitic limestone, and dolomite. Rodda and others (1970) also reported the upper 20 ft of member 1 to consist of an iron-stained, cavernous, solution-collapse zone containing brecciated limestone, dolomite, chert, coarsely crystalline calcite, and residual red clay. Lozo and others (1959) and Moore (1996) demonstrated that the lower part of the Edwards Formation interfingers with Walnut and Comanche Peak strata northward from Austin. Rose (1972) elevated the Edwards to group status with two formations for the region south of the Colorado River; he reported, however, that north of the Colorado River the Edwards should retain its single formational rank. The Edwards Formation is not subdivided in the map area. Vuggy textures, collapse breccias, cavern systems, chert, and local rudistids are characteristic of the unit (Rodda and others, 1970).

The Georgetown Formation consists of fossiliferous limestone, argillaceous limestone, and minor marl (Wilbert, 1967). These carbonate wackestones, packstones, and grainstones compose the upper unit of the Northern Edwards aquifer. Georgetown deposits thicken northward across the study area from ~60 to

110 ft. Diagnostic fossils include bivalves *Kingena wacoensis* and *Gryphaea washitaensis*. Vuggy porosity occurs within some beds, but vugs in Georgetown rocks are not as common as they are in Edwards rocks.

Overlying Georgetown rocks, the Del Rio Formation consists of ~65 ft of calcareous, fossiliferous claystone to mudstone. It serves as the confining bed for the Edwards aquifer. Pyrite and gypsum are common. Fossils of *Ilymatogyra arietina* (formerly *Exogyra arietina*) are common. Garner and Young (1976) reported that unweathered Del Rio clay is composed of kaolinite, illite, and lesser amounts of montmorillonite. During weathering, illite weathers to montmorillonite. Weathered Del Rio clay therefore contains only small quantities of illite and greater amounts of montmorillonite (Garner and Young, 1976). Del Rio deposits are usually poorly exposed in slopes below the more erosion-resistant Buda Formation.

The Buda Formation in the map area consists of a lower, slightly glauconitic, fossiliferous limestone and an upper, hard, resistant, burrowed, fossiliferous, shell-fragment limestone (Martin, 1967). The formation thins northward across the area from ~30 to <3 ft. Arrington (1954) reported Buda limestone to be absent at several places north of the San Gabriel River in Williamson County. He interpreted the area of missing Buda strata to be the result of pre-Eagle Ford erosion on a structurally high area. Undivided Quaternary surficial material covers much of the area, so it is also possible that the thin Buda was eroded from the area during the Quaternary (Senger and others, 1990). Regional studies indicate that the upper part of the Buda was eroded before Eagle Ford deposition (Adkins, 1932; Hayward and Brown, 1967; Martin, 1967). Truncated Buda limestone is overlain by a thin, less than a few feet thick, black shale interval that has been reported as the Pepper Shale, a shale facies equivalent to the Woodbine Formation of the East Texas basin region (Adkins, 1932; Feray and Young, 1949; Hayward and Brown, 1967; Martin, 1967). In the study area the thin Pepper shale interval is rarely exposed and is mapped with Eagle Ford shale deposits.

The Eagle Ford Formation consists of three lithologic intervals: a lower calcareous shale; a middle flaggy, silty limestone to calcareous siltstone; and an upper shale. Garner and Young (1976) reported that several thin, <3-inch-thick bentonite beds occur in the middle part of the unit in the Austin area. Eagle Ford deposits are ~23 ft thick in Travis County and thicken northward to ~65 ft in Williamson County. Adkins (1932), Feray (1949), and Young (1985) reported that a shale condensed zone, a few feet thick and having phosphate nodules, bounds upper Eagle Ford Formation at its contact with the Austin Group.

The ~140-ft-thick strata interval that consists of the Del Rio, Buda, and Eagle Ford Formations exhibits physical characteristics that are particularly important to construction practices. Clay-rich Del Rio and Eagle Ford strata and their soils exhibit relatively poor slope stability and foundation strength, and the clays have expansive properties that cause swelling when wet and shrinking when dry (Garner and Young, 1976). Buda Formation limestones that cap slopes of the Del Rio can sometimes be unstable because of the poor slope stability of the Del Rio clay.

The Austin Group, also called the Austin Chalk, represents ~360 to 425 ft of thin- to thick-bedded chalk, marl, and limestone deposited in an open shelf setting (Marks, 1950; Garner and Young, 1976; Young and Woodruff, 1985). Young (1985) described six formations in the Austin Group: the Atco, Vinson, Jonah, Dessau, Burditt, and Pflugerville. He also described a stratal sequence he called the Austin Division, which includes rocks between the disconformity at the top of the Eagle Ford and the disconformity at the base of the Taylor Group Pecan Gap unit. Young considered the Austin Division to be a genetic unit that includes Austin Group strata and an upper claystone unit, the Sprinkle Formation, which is typically mapped with the Taylor Group. Austin and Taylor strata in the map area are not well exposed. Austin Group rocks are exposed locally in stream beds, but Taylor strata are rare. Much of the land within the outcrop belts of these units is farmland. For this study, the Austin Group is undivided. Clay-rich deposits overlying limestone of the upper Austin Group are mapped as part of the lower Taylor Group.

Quaternary alluvial deposits are generally associated with modern streams, although some local remnant, older terrace deposits (Quaternary-Tertiary?) exist at higher elevations. In the Edwards outcrop belt and westward, streams have incised narrow valleys (Senger and others, 1990). Here, Quaternary alluvial deposits are thin and not areally extensive. Downstream from the Edwards outcrop belt, broad alluvial surfaces, which consist of terraces associated with active streams, as well as older, remnant terraces, are well developed. Some of the terrace deposits are at least 35 ft thick and may be thicker in some locations. Seeps and springs commonly occur at the contact between bedrock and terrace deposits (Senger and others, 1990). Most of the seeps probably discharge groundwater accumulated by surface infiltration into the porous alluvial sand and gravel.

Faults

The Balcones Fault Zone is a regional zone of normal faults along the perimeter of the Gulf Coast Basin (fig. 1 and map). This fault zone extends from near Del Rio, east-northeastward to San Antonio, where the zone bends northward through New Braunfels, Austin, Georgetown, and Waco and continues toward Dallas (Murray, 1961; Reasor and Collins, 1988; Ewing, 1991; Collins, 1995; Collins and Hovorka, 1997). Faults composing the zone are either more common or more pronounced between Uvalde and Georgetown. In general, faults in the map area strike north-northeastward and dip between 40° and 80°. Net throw across the fault zone is down toward the east, although faults dip both eastward and westward. Fault intensity and fault-zone structural relief decrease northward from Austin, where fault zone structural relief is ~1,600 ft (Collins and others, 2002). At the north boundary of the study area in southern Bell County, the fault zone's structural relief is ~600 ft (fig. 4). In Austin, south of the map area, maximum throw of the area's largest fault, the Mount Bonnell Fault, is nearly 600 ft (Collins and Woodruff, 2001). In the map area maximum displacements of larger faults are between 50 and 150 ft.

Large cross faults that strike subperpendicular to the north-northeast-striking structures were not recognized in the map area during this or earlier investigations (Collins, 1987; Senger and others, 1990). However, some minor, smaller-scale faults strike westward. Joint analysis along the San Gabriel River near Georgetown indicates that most joints follow two regional sets (Collins, 1987). Joints of one set strike northward between 340° and 020°. A second set of joints trend westward between 260° and 300°. Other joint sets may exist locally within the map area because Muehlberger (1990) noted several other regional joint sets in the nearby Austin area.

Resources

Throughout Central Texas, construction materials such as rock aggregate, building stone, cement, and sand and gravel are generally in demand owing to population growth and urbanization. In the map area Edwards and Georgetown rocks are quarried at relatively large-scale operations for aggregate and building stone. Smaller limestone pits that occur throughout rural areas are used mostly for road construction and maintenance. Terrace deposits in the map area provide a local potential source of sand and gravel resources. In other parts of Central Texas, lime for cement is quarried from Edwards and Austin limestones, suggesting that these units in the map area are a potential lime resource (McBride and others, 1992).

Groundwater resources of the study area include Edwards and Trinity aquifers (Klempt and others, 1975, 1976; Brune and Duffin, 1983; Maclay and Small, 1986; Senger and others, 1990; Jones, 2002). Groundwater from the Trinity aquifer (Glen Rose and older rocks), which underlies the Edwards aquifer, is used primarily in the west part of the study area, where Edwards strata are absent or too thin to

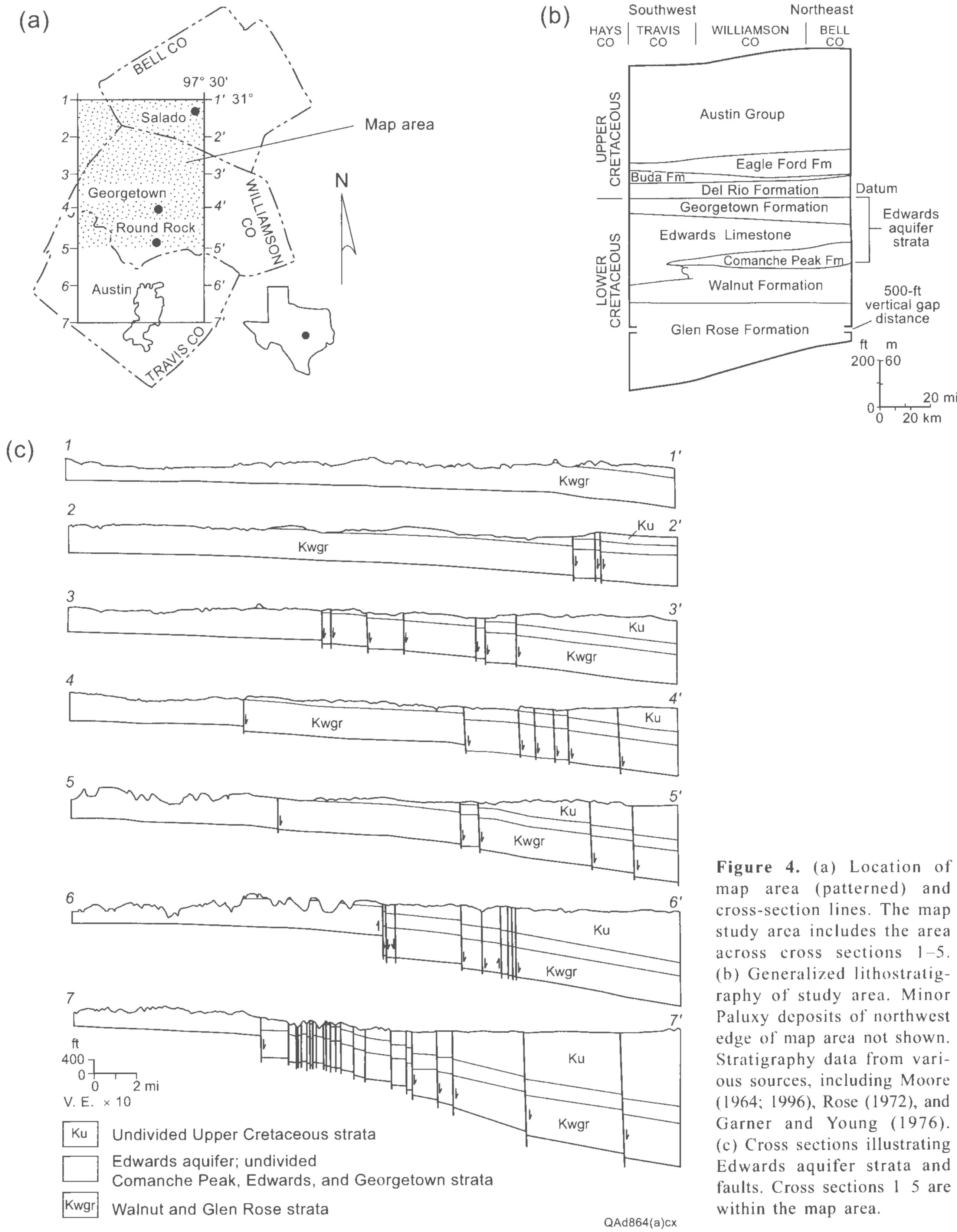

Figure 4. (a) Location of map area (patterned) and cross-section lines. The map study area includes the area across cross sections 1–5. (b) Generalized lithostratigraphy of study area. Minor Paluxy deposits of northwest edge of map area not shown. Stratigraphy data from various sources, including Moore (1964; 1996), Rose (1972), and Garner and Young (1976). (c) Cross sections illustrating Edwards aquifer strata and faults. Cross sections 1 5 are within the map area.

produce significant amounts of groundwater (Senger and others, 1990). In the area of the Edwards aquifer, groundwater from the underlying Trinity aquifer is rarely used.

This northern segment of the Edwards aquifer comprises Comanche Peak, Edwards, and Georgetown rocks. Vuggy textures, voids in collapse breccias, and cavern systems in Edwards strata are characteristic of the unit and account for most of the significant porosity in the limestones that compose most of the aquifer (Abbott, 1973). The confined, subsurface part of the aquifer ranges from ~420 ft in central Travis County to ~260 ft in southern Bell County (Collins and others, 2002). Faults control the structural position of the porous limestone units, similar to other parts of the Edwards aquifer (Collins and Hovorka, 1997; Collins, 2000; Ferrill and others, 2004). Faults can serve as conduits for groundwater flow, and at some locations faults may displace porous beds against relatively less porous beds, thus causing abrupt changes in groundwater flow paths. In their evaluation of the structural framework of the San Antonio segment of the Edwards aquifer recharge zone bordering San Antonio, Ferrill and others (2004) concluded that (1) constriction of groundwater flow paths may increase with the increase of fault-segment connectivity associated with large fault displacements, (2) fault-zone deformation associated with larger-displacement faults influences hydrologic properties, and (3) aquifer permeability is either unchanged or enhanced parallel to faults and in many cases decreased perpendicular to faults. These characteristics most likely also apply to the northern Edwards aquifer in the map area.

Locations of springs discharging from Edwards aquifer strata were studied by Collins and Woodruff (unpublished poster data, 2002) for the northern Edwards aquifer region in order for stratigraphic positions of the springs within the aquifer strata to be reviewed. Sixty springs were identified for the map area (fig. 5). These springs represent larger springs of the area and do not include the many small springs and seeps that occur throughout the region. Two of the larger springs are artesian and appear to be associated with faults. Thirty-four springs discharge near the contact between the Edwards and underlying Comanche Peak Formations, verifying porosity differences that exist between these units. Only one spring was identified within Georgetown strata. Seventeen springs discharge within Edwards strata, which contain the more porous strata of the aquifer rocks. Seven springs were also identified within interfingering Edwards, Comanche Peak, and Walnut strata overlying Glen Rose rocks at the southwest part of the map.

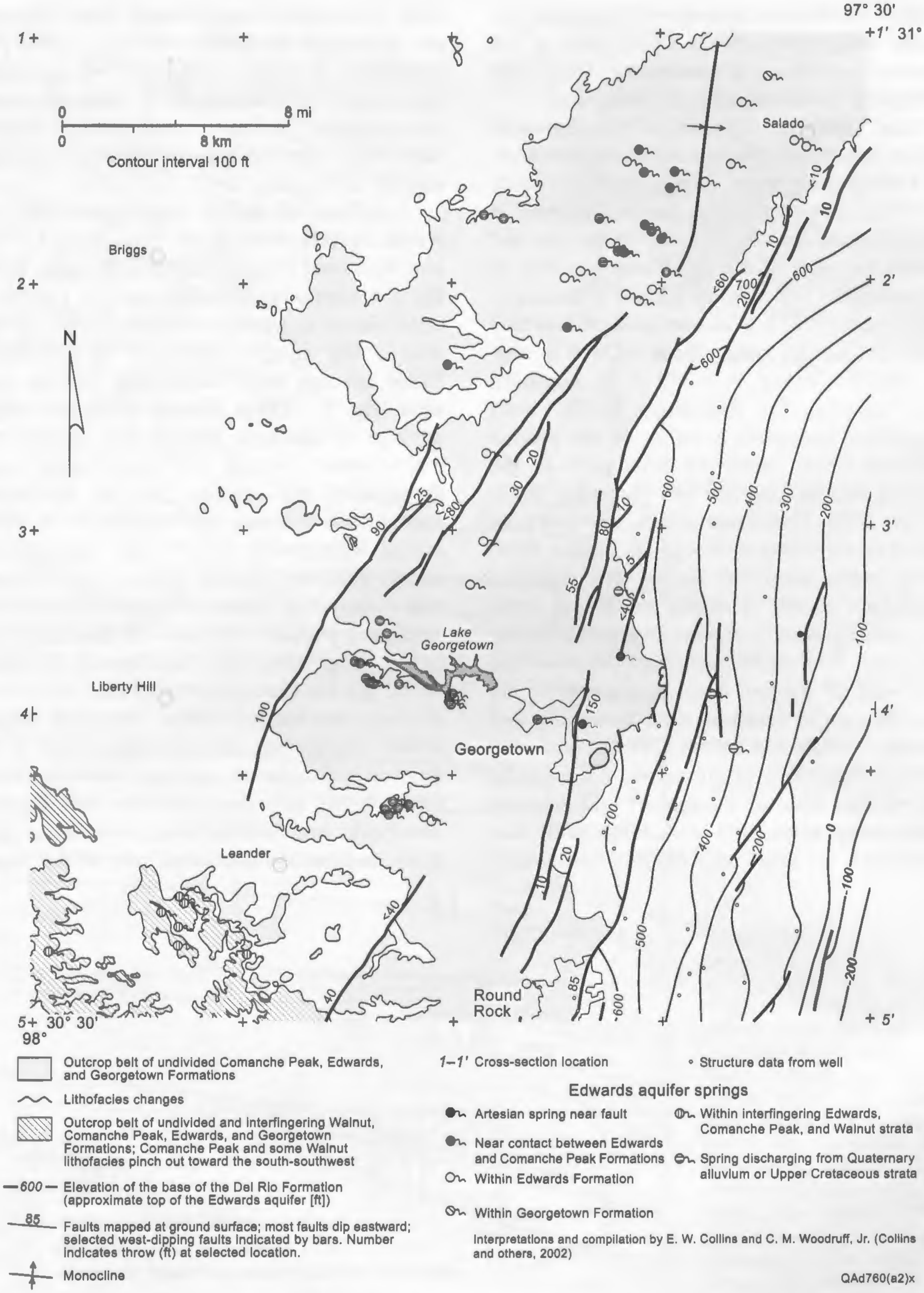

Figure 5. Edwards aquifer outcrop belt, location and stratigraphic position of springs, selected fault displacements, and structure contours on top of subsurface Edwards aquifer strata. Modified from unpublished poster data compiled by E. W. Collins and C. M. Woodruff, Jr. (Collins and others, 2002).

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